Claims 5-21 recite a "transverse" fiber device that includes an optical fiber and "a measurand surface adjacent to said second distal end of said fiber and ***parallel to said fiber core***" (emphasis added). In addition, Claims 5-21 recite the measurand surface to be "in a plane that intercepts with another plane defined by said end facet to form a line substantially perpendicular to said fiber core" and "is at least partially reflective to form an optical interferometer with said side fiber surface so that a first reflection of a beam produced at said side fiber surface interferes at said side fiber surface with a second reflection of the beam produced at said measurand surface."

Murphy discloses a reflecting surface 25 that is perpendicular to the fiber 14. The end facet of the fiber 14 is perpendicular to the fiber and is parallel to the reflecting surface 25. In Murphy, the reflected light from the reflecting surface 25 enters the fiber 14 via the end facet and mixes with light reflected back at the end facet. Hence, Murphy's device is different from Claims 5-21. Payne shows an angled fiber tip to send light out of the fiber and does not describe any mechanism for returning light from a surface into the fiber. Therefore, Claims 5-21 are different from Payne.

The Final Office Action, however, contends that Payne describes a fiber tip with a 45-degree end facet in FIG. 1 and

the combination of this disclosure in Payne and Murphy's devices in FIGS. 1 and 3 would render Claims 5-12 and 18-21 obvious. Applicants respectfully traverse.

Under 35 USC 103(a), the Patent Office has the initial burden to make a prima facie showing of obviousness. See, MPEP §2142. To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. MPEP §2143.

The Final Office Action, however, fails to meet the very first requirement that there must be some suggestion or motivation, either in the references Murphy and Payne themselves, or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Under MPEP §2143.01, THE PRIOR ART MUST SUGGEST THE DESIRABILITY OF THE CLAIMED INVENTION. The disclosures of Murphy and Payne, however, fail to suggest the desirability of the claimed invention.

Under MPEP §2143.01, there are three possible sources for a motivation to combine references: the nature of the problem to

be solved, the teachings of the prior art, and the knowledge of persons of ordinary skill in the art. In re Rouffet, 149 F.3d 1350, 1357, 47 USPQ2d 1453, 1457-58 (Fed. Cir. 1998). We first examine the first two sources (1) the nature of the problem to be solved by Claims 5-21 and (2) the teachings of the prior art references Murphy and Payne.

The "transverse" fiber devices recited in Claims 5-21 were invented to address very specific technical limitations of Murphy's fiber sensors. The original specification provides the following, beginning at the paragraph [0029] with added emphasis:

> *The transverse fiber interferometer 100 may be deployed in environments that have limited space or geometric constraints for receiving a sensing device. FIG. 2A shows one exemplary application of such a transverse fiber interferometer in a force-detected magnetic resonance spectrometer. A magnetized movable sample 201 or a movable sensing magnet 202 is located in a RF excitation coil 203 with a narrow gap between permanent magnets 210 and 212. The total magnetic field at the sample 201 is substantially homogeneous without a field gradient. The fiber probe 101 with the angled end surface 120 of the transverse fiber interferometer 100 can be inserted in various gaps between the magnets to measure the movement of either the sample 201 or the sensing magnet 202. Alternative to the magnet configuration for magnets 212 and 202, the magnet 212 may have a flat surface and the magnet 202 is placed above that flat surface with a gap therebetween. The fiber probe 101 can be inserted in this gap to measure the movement of the magnet 202.*

Hence, the specification of this application specifically points out the technical problem caused by the limited space or geometric constraints for receiving a sensing device. An example of a force-detected magnetic resonance spectrometer shown in FIG. 2A is used to illustrate how this problem may rise and how transverse fiber sensors as recited in Claims 5-21 may be deployed in such circumstances. More specifically, such transverse fiber sensors may be used in gaps or geometric designs in devices with dimensions as small as the diameter of the fiber sensing tip, in contrast to Doriath's or Murphy's inventions which apparently require many times the fiber diameter to launch and receive light.

Notably, the original specification specifically addresses the technical limitations of fiber sensors like the designs in FIGS. 1 and 3 by Murphy at the paragraph [0030]:

> *In such an instrument, it would be difficult to deploy a conventional fiber interferometer, which couples light longitudinally along the fiber axis to a measurand surface because portions of the magnets would need be removed to allow insertion of a fiber probe parallel to the static magnetic field. Hence, the design and performance of this spectrometer may by detrimentally affected.*

In this regard, the original specification states additional advantages of the "transverse" fiber devices recited in Claims 5-21 as follows:

> *Notably, since the fiber core 110 is essentially parallel to the measurand surface 130, the position of the second distal end 103 with angled end facet 120 can be externally modulated to oscillate perpendicular to its own axis. A positioning element may be used to control and modulate the position of the second end 103 relative to the measurand surface 130. In one implementation of the positioning element, one or more layers of piezoelectric material and electrodes may be deposited onto the surface of the second distal end 103 of the fiber 101 opposite from and parallel to the measurand surface 130 so that the fiber's distance from the measurand surface 130 may be adjusted or fed back without attachment of any extrinsic piezo actuators. This mechanism may provide a harmonic modulation of the light signal in addition to the modulation caused by the movement of the measurand surface 130. This could be utilized in applications where the fiber is itself driven in proportion to the quantity to be measured, or the fiber forms a mechanical element of the sensor. The reflective surface 130 external to the fiber 101 may in this case function as a point of reference for monitoring the change of position of the fiber probe. For example, the fiber may be used as a mechanical oscillator in a MEMS device or a force microscope. This modulation control of the fiber end can also be used to shift low-frequency or DC detected signals to higher frequencies in order to reduce noise. The fiber probe hence may be used to deliver a probe beam to a surface, modulate the return probe light in proportion to the measured quantity, and direct the modulated light to a receiver coupled to the first distal end 102 of the fiber 101.*

See, paragraph [0031]. The original specification goes on to describe additional examples shown in FIG. 2B to illustrate advantages of such a transverse fiber device.

A careful review of the disclosures of Murphy and Payne suggests that Murphy and Payne fail to recognize the technical problems addressed by the present application and further fail to suggest any solution to the technical problems. As such, Murphy and Payne fail to suggest the desirability of the claimed invention.

Let us examine the disclosure of Murphy first. Murphy discloses that the object of the invention is to provide an interferometric device for high temperature sensing of an optical path length change due, for example, to a change in pressure, strain, temperature, displacements, or chemical composition (Column 3, lines 21-25). Murphy further states that the invention is different from other high-temperature sensors in that a high-temperature sapphire fiber is used as part of the optical interferometer for optical sensing (Column 1, line 51-column 3, line 18). The fiber sensors in FIGS. 1 and 3 specifically use sapphire fiber 14 as the sensor tip and the combination of the fiber 14 and the reflecting surface 25 optical interferometer.

Therefore, the motivation for Murphy's fiber devices in FIGS. 1 and 3 was to provide optical interfermetric sensing in a high-temperature environment. Accordingly, Murphy invented the use of a segment of sapphire fiber in a fiber sensor to stand a high temperature above 2000°C. Nothing in the disclosure of

Murphy suggests that Murphy recognized technical issues in sensing applications where the space for placing a fiber sensor is limited.

Turning to the disclosure of Payne, the motivation of Payne's invention is, as suggested by the title of the patent and the detailed disclosure, to provide a fiber tip for delivering light carried by the fiber out of the fiber. The fiber tips described by Payne were designed to send guided light out of the fiber in a specific way. Payne did not suggest in any way that such fiber tips be used for collecting light. Payne certainly did not suggest that such fiber tips be used for a fiber interferometer sensor.

Furthermore, the disclosure of Payne describes the 45-degree fiber tip as one way of reflecting light guided in the fiber out of the that fiber. Payne further describes other fiber tip designs such as the tip in FIG. 4 that uses a total internal reflection to reflect guided light out of the fiber. The disclosure of Payne fails to suggest or hint other uses for the 45-degree fiber tip. In particular, the disclosure of Payne fails to suggest that the 45-degree fiber tip may be used for a fiber interferometer sensor and that the 45-degree fiber tip in Payne allows a fiber sensor to be used in spaced-limited conditions.

In view of the disclosures of Murphy and Payne, Applicants respectfully suggest that Murphy and Payne do not suggest any motivation for the combination as contended in the Final Office Action based on the (1) the nature of the problem to be solved and (2) the teachings of the prior art.

We now examine the third possible source for the motivation for the contended combination in the Final Office Action: (3) the knowledge of persons of ordinary skill in the art. The law in this subject is clear: the level of skill in the art cannot be relied upon to provide the suggestion to combine references. Al-Site Corp. v. VSI Int'l Inc., 174 F.3d 1308, 50 USPQ2d 1161 (Fed. Cir. 1999). In re Rouffet, 149 F.3d 1350, 1357, 47 USPQ2d 1453, 1457-58 (Fed. Cir. 1998), the combination of the references taught every element of the claimed invention, however without a motivation to combine, a rejection based on a prima facie case of obvious was held improper.

Applying the above rules here, the Final Office Action apparently violates the rules by stating that "it would have been obvious to one of ordinary skill in the art at the time of the invention was made to apply the tip of Payne to the device of Murphy in order to clarify the actual function and specifications of the second fiber end" (page 3, lines 5-8). This is because Murphy and Payne do not provide a motivation to combine.

Independent of the above arguments, the contended combination in the Final Office Action is improper also because the combination is made entirely on the hindsight after the benefit of the disclosure of this application. This is not permissible under 35 USC 103(a).

Based on the above reasons, the combination of the cited Murphy and Payne is improper due to lack of motivation to combine Murphy and Payne, and due to hindsight. Therefore, all rejections based on the combination are improper and must be withdrawn.

Claims 13-15 and 16-17 also stand finally rejected over Murphy in view of Payne and in further view of Hong or Doriath. The arguments made above are applicable here. In addition, Murphy, Payne, Hong and Doriath fail to provide any motivation for the combinations as suggested by the Final Office Action.

Therefore, the combinations in the Final Office Action are improper under 35 USC 103(a) and the rejections based on such combinations must be withdrawn. Accordingly, Claims 5-21 are distinctly different from and are patentable over the cited references. Applicants respectfully suggest that there is no other outstanding issue on the merits of the claims and the application is in full condition for allowance.

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Respectfully submitted,

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